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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/549,859	06/06/2006	Yasuo Kobayashi	033082M280	7185

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SMITH, GAMBRELL & RUSSELL

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WASHINGTON, DC 20036

EXAMINER

MILLER, MICHAEL G

ART UNIT

PAPER NUMBER

1712

MAIL DATE

DELIVERY MODE

10/04/2011

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

**Office Action Summary****Application No.**

10/549,859

**Applicant(s)**

KOBAYASHI ET AL.

**Examiner**

MICHAEL G. MILLER

**Art Unit**

1712

**Period for Reply** -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 02 May 2011.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 5) ☒ Claim(s) 1,3-5 and 9-12 is/are pending in the application.
- 5a) Of the above claim(s) 9-12 is/are withdrawn from consideration.
- 6) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 7) ☒ Claim(s) 1 and 3-5 is/are rejected.
- 8) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 9) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 12) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-884)  
Paper No(s)/Mail Date \_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_

**DETAILED ACTION**

***Continued Examination Under 37 CFR 1.114***

- 1) A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 02 MAY 2011 has been entered.

***Response to Amendment***

- 2) As a result of the amendment filed 02 MAY 2011:
  - a) Claims 1, 3-5 and 9-12 are pending.
  - b) Claims 9-12 are withdrawn.
  - c) Claim 1 is amended.

***Response to Arguments***

- 3) Applicant's arguments filed 02 MAY 2011 have been fully considered but they are not persuasive.
- 4) Applicant's first argument is that Endo does not mention an antenna. Examiner respectfully disagrees; Column 4 Line 13-15 of Endo describes a waveguide which conducts the radiation into the chamber. Examiner apologizes for the error in line numbering.
- 5) Applicant's second argument is that a proper prima facie case of obviousness has not been established with regards to why a material with the required characteristics

would have been obvious to a person having ordinary skill in the art at the time the invention was made. Examiner respectfully disagrees, citing Point 9 Items h-k of the previous Office Action. The primary reference, '518, was silent as to the electron temperature, electron density, dielectric constant and leakage current of the plasma and film. The secondary reference, '621, is a plasma generation reference and teaches a high electron density; the tertiary reference, '457, teaches that it is known to be able to reduce electron temperatures without affecting the plasma density, with the advantage that the low temperatures reduce substrate damage. Therefore, as '518 wants a plasma generation means for forming CF films on a substrate and '621/'457 teaches a plasma generation means using parameters which reduce damage to the substrate, it is obvious to combine the references. From there, '704 teaches a CF film having a low dielectric constant and low leakage current potentials; this is significant because '518 is also forming CF films and as such again renders obvious the combination of the references. '975 is drawn to an apparatus capable of producing the conditions desired by '621 and '457, and again as such is an obvious combination with these references.

- 6) Applicant notes that the amendment requires that the antenna is required to be made of a conducting material. Examiner points to Column 7 Line 66 – Column 8 Line 31, which teaches that the electric power supplied from a microwave source passes through the annular wave guide tube filled with the second dielectric material. If the power can pass through the material, the material is conducting the power.

***Claim Rejections - 35 USC § 103***

- 7) The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

- 8) The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

- 9) This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

- 10) Claim 1 and 3-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Endo (U.S. Patent 6,429,518, hereinafter '518) in view of Redeker et al (U.S. Patent 5,800,621, hereinafter '621), Okumura et al (U.S. Patent 6,093,457, hereinafter

'457), Endo et al (U.S. Patent 6,197,704, hereinafter '704) and Suzuki (U.S. Patent 5,803,975, hereinafter '975). Schuegraf et al ("Ultra-thin Silicon Dioxide Leakage Current and Scaling Limit", 1992 Symposium on VLSI Technology Digest of Technical Papers, pp 18-19, hereinafter Schuegraf) is cited as evidence of material properties.

- 11) Claim 1 – '518 teaches a plasma-assisted deposition method (Figure 1) for forming an insulating film on a substrate (W) placed on a support device (41) in an airtight processing vessel (2 generally) by activating C5F8 gas (Column 16 Line 65 – Column 17 Line 7) by a plasma forming gas (Column 8 Lines 30 - 43 and Column 16 Lines 65-67), the method using a plasma-assisted deposition system (if a plasma is formed to break down the gas, it is inherently plasma-assisted) and comprising:
- a) Radiating a microwave in a flat antenna member disposed opposite to the support device (Column 4 Lines 9-13);
  - b) Guiding the microwave by a wave guide into the airtight processing vessel (Column 4 Lines 13-21);
  - c) Supplying the plasma forming gas, including a rare gas, into the airtight processing vessel with a plasma forming gas discharge head disposed between the flat antenna member and the support device (Column 4 Lines 23-28);
  - d) Supplying the C5F8 gas into the airtight processing vessel with a C5F8 gas discharge head disposed between the plasma forming gas discharge head and the support device, while conducting the plasma forming gas vertically through a

- plurality of through holes in the C5F8 gas discharge head (Column 4 Lines 38 – 46; the gas must be conducted vertically in order to reach the substrate);
- e) Providing a processing atmosphere pressure of 19.95 Pa or below (Column 8 Lines 30-43, process pressure of 0.5 Pa taught at Line 34); and
- f) Depositing on the substrate the insulating film which is a fluorine-containing carbon film (Column 3 Lines 51-52).
- g) '518 is silent as to the electron temperature, electron density, dielectric constant or leakage current of the plasma and film.
- h) '621 teaches a plasma process wherein high density plasma of  $1 \times 10^{11}$  to  $2 \times 10^{12}$  ions /  $\text{cm}^3$  are generated at electron temperatures comprising a few eV (Column 1 Lines 12-20); the electron density will be no less than half this amount (in the case of monovalent ions, which will divide as  $A^+$  and  $e^-$ ) and will be a generally higher amount (in the case of polyvalent ions, such as  $A^{++}$  and  $2e^-$ , this specific case would have an electron density that is  $2/3$  the ion density); '457 expands on this teaching by saying it is known to lower electron temperatures to 2eV or lower without affecting the plasma density (Column 1 Line 64 - Column 2 Line 23). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have combined the process of '518 with the plasma parameters of '621/'457, as '518 is open to many means of plasma generation and '621/'457 teaches a workable set of plasma parameters with the advantage that the low eV temperatures will reduce damage to the substrate ('457 Column 1 Lines 40-42).

- i) '704 teaches that it is advantageous to use CF films in semiconductor applications because they have a parasitic capacity (leakage current) 50% lower than that of silicon dioxide as well as a lower dielectric constant than that of silicon dioxide (Column 2 Lines 6-32 generally, Lines 6-15 for the teaching of an amorphous CF film with a dielectric constant of 2.3, Lines 28-32 for the leakage current teaching). It is known in the art of semiconductors that materials having a low dielectric constant are desirable as insulative interlayers. Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have produced a CF film in the manner of '518/'621/'457 targeting the properties detailed in '704, as both teachings want to make insulating films and '704 teaches an advantageous film possessing the desired properties. Figure 7 of Schuegraf provides evidence that it is possible to obtain leakage currents of  $1 \times 10^{-8}$  A/cm<sup>2</sup> in silicon dioxide; by the teachings of '704, this would permit the formation of CF films which would have a leakage current of  $5 \times 10^{-9}$  A/cm<sup>2</sup>. It is to be noted that even if no reduction occurs by use of CF films, the leakage current is still five times less than what is claimed.
- j) '975 teaches a plasma deposition system with an annular wave guide tube (Column 3 Lines 20-26) comprising a flat cylindrical top and bottom into which a microwave is introduced (Figure 3), the inner cylindrical surface of which comprises slots half the width of the guide wavelength (Column 6 Lines 40-45). This system is capable of generating plasmas with temperatures of 3 eV or less and electron densities of  $1 \times 10^{12}$  electrons / cm<sup>3</sup> (Column 3 Lines 26-35),



which is within the parameters described in '621/'457. Therefore, it would be obvious to a person having ordinary skill in the art to have combined the method of '518/'621/'457/'704/'Schuegraf with the apparatus of '975 as '975 is shown to be capable of producing plasma conditions deemed desirable by '621/'457.

Further, as the electrical power passes through the annular wave guide (Column 7 Line 66 – Column 8 Line 31), the antenna is made of a conducting material.

12) Claim 3 – As discussed above, the slots have a length that is half the wavelength of the guide wave ('975 Column 6 Lines 40-45).

13) Claim 4 – As shown in Figure 3 of '975, the slots are disposed in a concentric circle around the center of the antenna member.

14) Claim 5 – The internal curvature of the guide wave tube produces a circularly polarized wave ('975 Column 6 Lines 45-50; incidence angles below a certain threshold lead to absorption, while incidence angles above a certain threshold lead to total reflectance; this alignment of angles by subtraction is a polarization effect).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL G. MILLER whose telephone number is (571)270-1861. The examiner can normally be reached on M-F 9-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on (571) 272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MICHAEL G MILLER/  
Examiner, Art Unit 1712

/Michael Cleveland/  
Supervisory Patent Examiner, Art Unit 1712